agricultural research

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A Protein Perspective

Dire predictions of a so-called protein crunch keep appearing in the press. Their gist: mass starvation if food production does not keep pace with the world population growth over the next 50 years. Since protein is expected to become the most limited nutrient, many writers are urging that grain be consumed directly by people rather than be fed to livestock, especially beef cattle, which they portray as grossly inefficient converters of grains and oilseeds into meat, thereby reducing the world's food supply.

People have long practiced several kinds of vegetarianism—and that is a basic right—but most of us want meat in our diets. Observers who contend that grain must inevitably replace meat as a protein staple fail to take into account basic realities concerning ruminant livestock and agricultural science. For such ruminants as cattle and sheep are superbly endowed to thrive on forages—pasture and harvested herbage—converting fibrous material that people cannot eat into protein-rich meat and milk. Indeed, forages account for about 70 percent of the nutrients that beef cattle consume over their lifetimes. This is a notable statistic because over half the total U.S. land area—about a billion acres—is fit not for cropping but for producing forage. Urban societies, it appears, need more public awareness about the food production that goes on in that miracle chamber, the rumen.

In the dark of a cow's rumen are Lilliputian armies of microbes that digest and mobilize nutrients for the cow to assimilate. Some microbes digest cellulose, others make certain vitamins, still others make digestible protein for the cow, either from nonprotein nitrogen present in forages or that fed as urea. The ruminant's "fermentation vat" can also digest many wastes from the processing of food for human consumption. These include byproducts from preparing flour, starch, glucose, sugar beets, and distillery products as well as meatpacking wastes. Another feed source that scientists are working to exploit is the mountain of high-fiber wastes produced each year, especially straw. If straw could be rendered digestible, it could maintain 49 million head of cattle.

Urea looms large in meeting the future feed needs of ruminants. Although some problems remain to be worked out, more urea is being fed to cattle. A measure of its promise is attested by a 10-year-old bull at Beltsville which has since the age of 84 days obtained all its nitrogen from urea. Agricultural scientists of many disciplines are striving to find and develop new sources of protein. Even so, the ruminant will maintain its age-old role as a major contributor of protein-rich meat for tomorrow.

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COVER: Dr. Hofreiter observes simple test demonstrating the repulping abilities of paper treated with dialdehyde starch vs. paper treated with resin. The dialdehyde starch-treated paper has broken into fibers after being agitated for 3 minutes in a mildly alkaline warm water solution of sodium carbonate (0274X207–41). Article on page 8.

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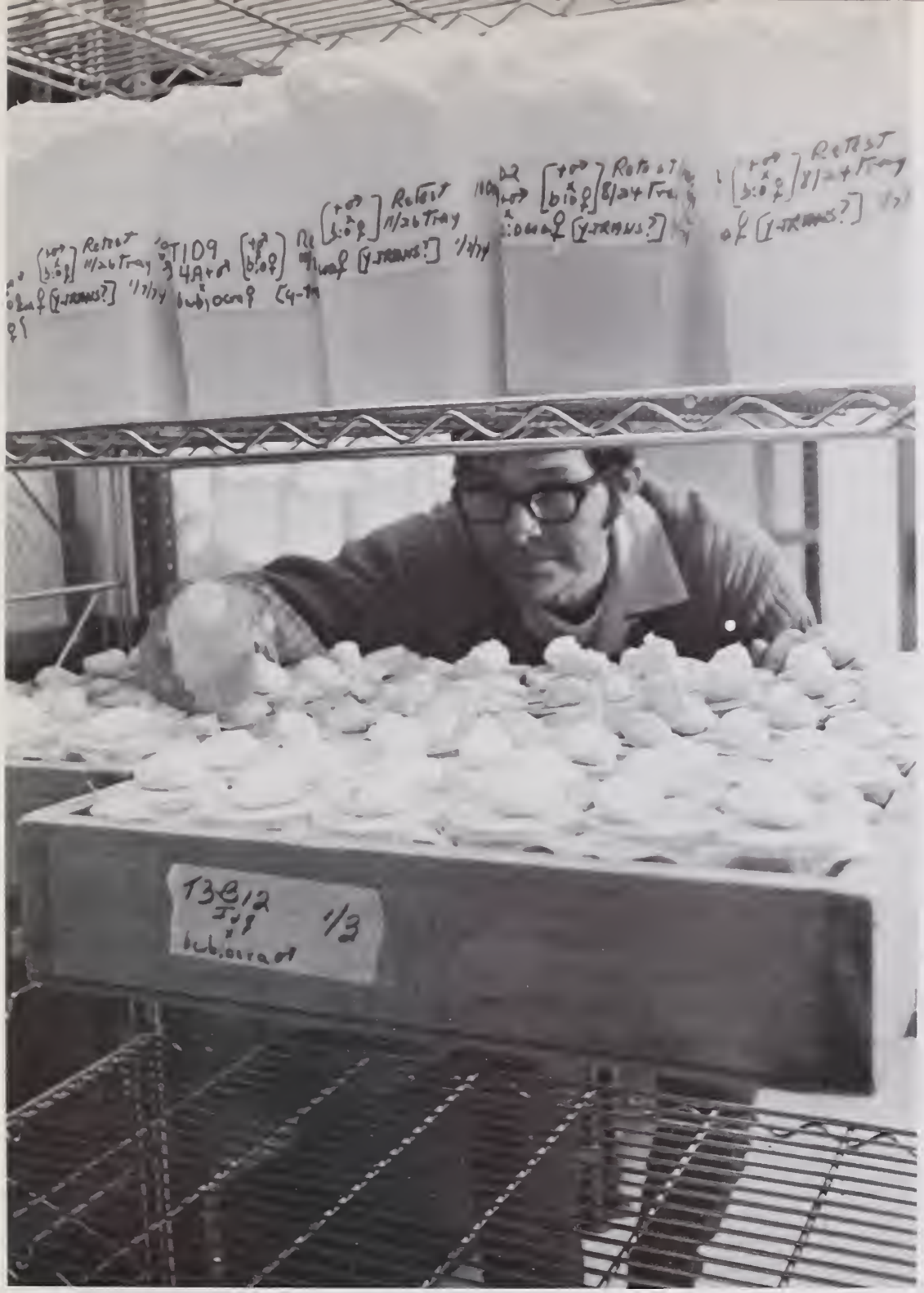


Research assistant Odell Johnson feeds sugared water to individual paired matings of house flies. Good treatment extends their lives and results in more progeny (174X57–22).

'Male only' House Flies

If male house flies genetically altered so that they were capable of siring only male offspring in nature were introduced in sufficient numbers, the native population could be controlled in an environmentally safe manner.

Initial steps have been taken at the ARS Metabolism and Radiation Research Laboratory, Fargo, N. Dak., toward such a genetic control technique. Scientists there have developed house fly strains in which the males, when mated with females of most native strains, produce only male progeny. Matings that occur within these new strains produce both males and females.

Geneticist Dale E. Wagoner says the final effect of releasing males of such strains in nature would be identical to that obtained by releasing male house flies rendered sterile by exposure to irradiation or a chemosterilant. When a male-producing insect mates with a native female, no female progeny are

Dr. Wagoner inspects cages housing mutant strains of house flies (0174X56–14).

produced; when a sterile insect mates with a native female, no progeny result.

If males of either type were introduced in overwhelming numbers, an isolated house fly population would decline and might eventually be eliminated. Dr. Wagoner points out that males of the genetically modified strain may be more competitive in nature than sterilized insects that have been treated with relative large doses of irradiation or chemosterilants.

In addition, use of a male-producing strain and sterilization might be combined in a control program. If release of male-producing males ever produced an excess of males in the field, these males could be collected, mated with virgin females in the laboratory, and their all-male progeny sterilized for release. The cost of rearing insects for a sterile release program would be cut in half because no females would be produced.

Scientists would prefer to sterilize and release only males because females usually mate only once while males mate many times. Separating the sexes by mechanical devices is not 100-percent efficient, and hand-sexing is both time-consuming and costly.

Further research might open the way for an even more sophisticated genetic technique for house fly control. Dr. Wagoner suggests the possibility of developing a house fly strain that could be programmed to produce only males in the laboratory as well as in nature. Such a strain might incorporate characteristics of his male-producing lines and those of a strain developed earlier by ARS entomologist Ian C. McDonald (AGR. RES., Feb. 1972, p. 10).

Dr. McDonald combined two genetic characteristics in strains of flies. These characteristics are a recessive heat-sensitive lethal factor and a dominant male-determining factor in a strain that may be managed for production of only male offspring. The heat-sensitive factor halts development of females in the late larval or early

pupal stage when the flies are reared at 92° F. in the laboratory. Males of this strain produce both male and female progeny in the field.

Perhaps, Dr. Wagoner theorizes, a heat-sensitive lethal factor—but one that is dominant and acts against potential females during the egg stage—and a dominant factor responsible for production of males only in the field could be incorporated into a single strain. Costs of rearing insects for release would be cut in half by using the restrictive temperature to insure that only males would be produced in the laboratory. And these males would sire only male progeny when released and crossed with native females.

To develop the male-producing strains of house flies, Dr. Wagoner and entomologist Odell A. Johnson made crosses between strains from Florida and Australia that have different types of sex-determination systems. At least four systems operate in strains of house flies from different geographic origins, but the strains interbreed freely in the laboratory.

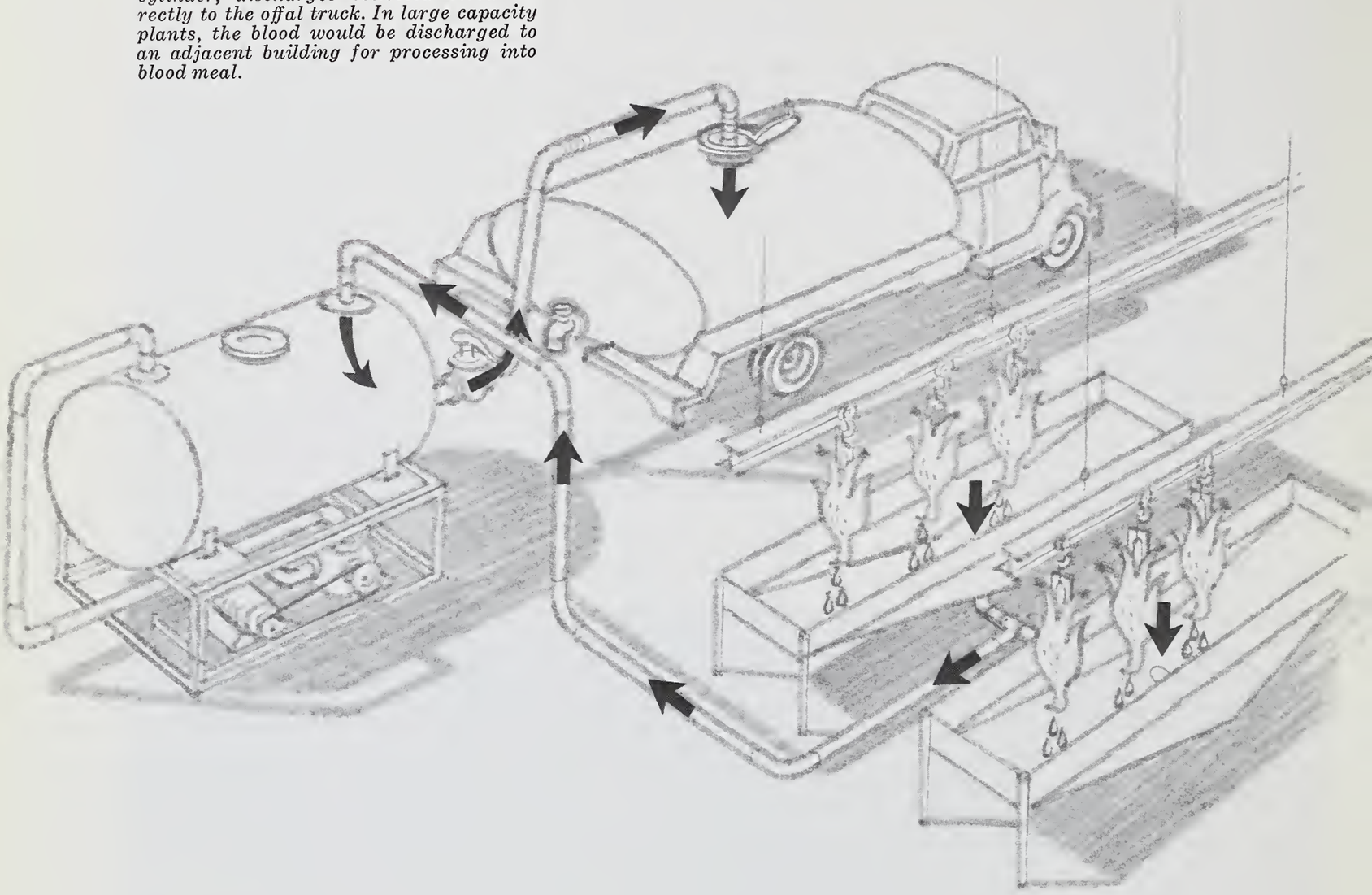
The wild-type house fly from Florida has a dominant male-determining factor on the third chromosome. The Australian strain has dominant male-determining factors on the second, third, and fifth chromosomes as well as one or more dominant female-determining factors. Determinants for both sexes are present in Australian females, but the male-determining factors are suppressed or masked in the females.

In crosses between Florida-strain males and Australian-strain females, some male progeny have dominant male-determining factors on both of their third chromosomes—one received from each parent. These males, in turn, can sire only male offspring when they mate with females of any house fly strain lacking the Australian type of female-determining factor or factors.

Dr. Wagoner and Mr. Johnson have produced five strains by crossing Florida males and Australian females. Four strains have produced males only through 19 generations when the males were mated with females of other housefly strains. About 2 percent females were produced in similar matings with the fifth strain in the ninth generation, probably because the strain was contaminated. □

Doubly mutant house flies are deftly separated by sex under a dissecting scope (0174X56–30).

Blood is collected in catch basins, then transferred by pneumatic tubes to the collection tank. The tank, equipped with a quick-opening valve operated by an air cylinder, discharges collected blood directly to the offal truck. In large capacity plants, the blood would be discharged to an adjacent building for processing into blood meal.



Cleaner poultry processing

SCIENTISTS have developed a new automated blood collection system for poultry processing plants, a system which prevents almost all collectible blood from getting into the plant effluent.

In current processing methods, the blood usually collects on the floor of the slaughter area until the end of the work shift. There the serum separates and drains into the massive streams of water necessary to float the waste material out of the processing area. Water use is estimated at over 10 gallons per bird or 1 million gallons per day in large processing plants. The collectible blood resulting from the processing of 10,000 chickens per hour—an average number for most plants—is 130 gallons of blood per hour. These bloody streams are repugnant; moreover, in terms of environmental pollution, they spell trouble.

Poultry processors already are walking an economic tightrope between competitive conditions and slim profits. Now the industry is facing recently enacted legislation which demands major housecleaning.

ARS researchers at the Richard Russell Center's Environmental Engineering Laboratory in Athens, Ga., may have one answer—a mechanical system

consisting of heavy duty vacuum equipment with lines attached to a 500-gallon collection tank. Blood is collected by pneumatic tubes from specially designed catch basins and transferred to the collection tank. The tank is equipped to discharge blood through a quick-opening valve operated by an air cylinder. From the collection tank the blood goes directly to the offal truck. Both tank and vacuum lines are "clean-in-place," having a built-in pipe system to flush them out with water. The entire system operates automatically.

Blood has been identified as the main source of biological oxygen demand (BOD), which is the amount of oxygen needed to cause the waste, primarily blood and grease, to denature in the effluent. Because the amount of blood that enters the effluent is greatly reduced, the BOD factor is also reduced, thus drastically reducing pollution.

This system constitutes a continuous rendering operation; consequently, clean-up labor is reduced. Other obvious advantages are a cleaner, more wholesome work area within the processing plant and savings in water requirements.

To augment the new system, researchers are testing a method to process the blood by means of an improved cooking technique to produce a water soluble, freeze-dried blood meal. It is a high quality protein supplement for feed which can also be used as a constituent of plywood glue.

"We estimate that use of the blood collection system by processing plants in the United States—probably there are more than 700—would save the industry from 2 to 3 million dollars a year," says engineer Rex E. Childs. "This would accrue from labor savings, pollution abatement, and the revenue received from the sale of collected blood."

Developed and tested commercially by engineering technician E. J. Lloyd and Mr. Childs, the blood collection system is the first component of an overall handling system for all wastes from poultry processing plants. □

a delayed response...

If planting and growth conditions were ideal, but a grower's cotton planting germinated slowly and produced less than expected, he should look backward a full year. Chances are low night temperatures of the previous season during seed maturation may be to blame.

Studies conducted during the past few years by several researchers indicate that seeds produced late in the season are small, low in both protein and oil content, high in free fatty acids, and have low germination rates.

A recent study conducted cooperatively at Lubbock, Texas by ARS geneticist Jerry E. Quisenberry and Texas A & M University Professor Jack R. Gipson was designed to (1) confirm the effect of night temperatures on seed quality and (2) evaluate the effect of seed quality on the growth and productivity of cotton.

Four commercial varieties, representing a broad spectrum of varietal types, and a semi-dwarf experimental strain were used in the tests. Thermostatically controlled growth chambers were placed over the field plantings of each variety during the night (and removed during the day) to maintain four night temperature regimes, 52° 59°, 70°, and 81° F.

Seeds produced from each of the varieties grown under each of the temperature regimes was designated as a treatment-variety combination. There were 20 such variety combinations.

Seeds produced under 52° F. night temperatures were uniformly poor in quality, and seeds produced under a night temperature of 59° F. varied in quality. At the two higher temperatures, 70° and 81° F., seeds of all varieties were high in quality.

Seeds from the two lower temperatures emerged much more slowly than those from the higher temperatures and the disparities continued through early and late growth stages (planting to first square, and first square to first flower, respectively) and finally were evidenced in productivity.

For example, percentage of germination of seeds produced under a night temperature of 52° F. averaged only 19.8 percent for all varieties, while the rate for those grown under a night temperature of 70° F. was 92.6 percent.

The real differences, as might be expected, showed up in plant productivity. Seed cotton averaged only 36 grams per plant for those plants grown from seed matured at 52° F. night temperature, while plants grown from seed matured at 70° F. night temperature averaged 50 grams per plant, a difference of almost 30 percent. Average number of bolls produced by the same treatment conditions were 8 and 10.9, respectively.

Differences in growth rates were not nearly as pronounced as the differences in both germination and productivity. Early growth rates ranged from 0.25 to 0.30 centimeters per day, a difference of just over 15 percent. Late growth rate ranged from 0.94 to 1.02 centimeters per day. □

CONTRARIES vs. TEMPORARIES

THE paper industry's need to conserve energy and wood pulp is fostering competition between two classes of wet-strength agents in a contest billed as "the temporaries vs. the contraries."

Typically, some 10 to 15 percent of a paper mill's output ends up as "broke" or waste stock, mainly trimmings and other mill scraps of premium quality. Paper mills routinely repulp these wastes then recycle the resulting "new" pulp, thereby conserving energy, timber, and other sources of cellulose materials.

Repulping of mill paper wastes would be greatly simplified if the fraction treated for wet-strength characteristics utilized an improved form of dialdehyde starch which is in the vanguard of the "temporaries." Dialdehyde starch was developed at the Northern Regional Research Laboratory, Peoria, Ill., about 15 years ago and significantly improved in 1973. ARS chemists specifically designed it to serve as an additive to wood pulp for maintaining the strength of paper products that get wet in use—toweling, tissues, and grocery bags carrying wet foods, for example. Dialdehyde starch is called a "temporary" wet-strength agent because paper containing it, when wet, slowly releases the bonds which hold together the wood fibers in paper. This trait greatly facilitates the repulping of wet-strength treated paper.

About 20 percent of the annual U.S. pulp requirements for paper and paperboard is met by waste paper. Included in this segment are the some 2 million tons of wet-strength paper produced annually, paper containing hidden resins that, unlike dialdehyde starch, cling so stubbornly to pulp fibers as to earn the name of "contraries." Energy requirements for repulping such paper now run as high as 15 kilowatt hours per ton.

Since the hidden "contraries" are difficult to identify as well as to disintegrate, rather than being repulped such paper is sometimes burned or buried in landfills, contributing to air or water pollution.

Some industry authorities "have suggested that use of papermaking chemicals that hamper repulping will be coming under closer scrutiny," says Bernard T. Hofreiter, Northern Laboratory chemist leading new studies on dialdehyde starch.

Made from corn starch and commercially available as a dry, white powder since early 1960, dialdehyde starch heretofore required a precise cooking process at the paper mill. Some mills, especially smaller ones, are not equipped to handle the precision processing.

Now dialdehyde corn starch can be easily made as a ready-to-use liquid. Dr. Hofreiter and chemists Harley D. Heath, Adrian J. Ernst, and Charles R. Russell have made cationic dispersions of dialdehyde starch containing up to 15 percent of solids. These dispersions have remained stable in storage for more than 7 months.

"Now dialdehyde starch is as easy to get into paper as it is to get out," says Dr. Hofreiter. This easy-out repulping performance contrasts with that of the hidden "contraries."

"We haven't lost the temporary wet strength or ease of repulping," says Dr. Hofreiter. "We get wet strength that drops 55 percent with 48 hours' soaking, which leaves its strength adequate for many uses."

In the Peoria research, scientists made coarse paper, like that used in bags, with ready-to-use dialdehyde starch, then repulped it at room temperature and pH 11. The repulping rate.

Left: An "off the reel" test of paper treated with dialdehyde starch is made by machine operator William Hensley. By first wetting and then rubbing the finished product, he will qualitatively determine the paper's wet strength (1272A1547–1). ***Above:*** *Defibering of repulped unbleached kraft paper is checked by Dr. Hofreiter and paper maker Leo Curtis at the plant's 600-gallon capacity pulper (1272A1548–9).* ***Right:*** *Whoops! A shopping bag without wet strength and a leaky package teamed up to cause this accident. Fewer than 1 percent of today's shopping bags are treated with wet strength agents; most contain a temporary sizing that will not protect them against disintegration when soaking wet (0274X206–15).* ***Lower Right:*** *Chemist Adrian J. Ernst pours 15 percent cationic dialdehyde starch solution into the tank that supplies the paper-making machine. Automatic meters feed the solution into the process in precise, predetermined amounts (0274X208–3A).*

surprisingly, was slightly faster than for untreated control paper at neutral pH. This research indicates that dialdehyde-treated paper can be chemically unlocked so that it can be readily repulped. Repulping can be achieved in less time and at lower temperature in the pulper, with considerable saving of energy.

Pulp reclaimed from dialdehyde starch-treated paper was used again to make good quality paper on the Northern Laboratory's pilot machine.

An ARS memorandum of understanding provides for industrial research on the new, liquid form of dialdehyde starch at Sumner Division, Miles Laboratories, Elkhart, Ind. The research is underway. □

The unwanted. Time exposure photo reveals the flight patterns of swirling insects illuminated under a mercury vapor dawn-to-dusk security light (PN–2857).

Sodium vapor lamps attract fewer insects

OUTDOOR electrical lighting by high-pressure sodium vapor lamps may be preferable to lighting by most mercury vapor lamps for two reasons—less insect attraction and more light output from a given amount of electrical energy.

A cooperative study by ARS and Purdue University Agricultural Experiment Station personnel was conducted at Lafayette, Ind., on the attractiveness of various lamps to nocturnal insects. Scientists were seeking answers to questions posed by sanitation engineers, lighting system designers, and managers of processing plants and industries that operate at night.

The research team mounted six kinds of lamps individually in insect traps and placed the traps in a cornfield and in an open meadow. Insects were identified by 29 species or selected groups. Then the lamps were compared on the basis of the numbers of insects caught and the frequency of the catch.

Lamps that the researchers evaluated in the study included 50-watt (w) and 175-w clear mercury, 15-w BL (black-light) fluorescent, 275–w high-pressure sodium vapor, and 400-w yellow and 400-w clear mercury vapor lamps.

ARS agricultural engineer John R. Barrett, Jr., said the 400-w clear mercury lamps attracted about three times as many insects as the yellow mercury lamps or the sodium lamps. Moreover, light output from the sodium lamps was slightly greater than output from the clear mercury vapor lamps, and more than double the output from the yellow mercury lamps. Mr. Barrett noted that initial equipment cost could be expected to be greater for the sodium units than for the mercury lamps.

The fluorescent BL, 50-w, and 175-w clear mercury lamps were, respectively, 49, 87, and 95 percent as attractive to insects as the 400-w clear mercury lamps.

It was demonstrated in these tests that to design lighting systems for minimal insect attraction, one should use lamps that produce minimum amounts of ultraviolet and blue wavelengths of light and maximum amounts of yellow-red wavelengths as sodium or yellow mercury lamps do, Mr. Barrett said.

The clear mercury lamps emit wavelengths in the near-ultraviolet range. These lamps, used in the tests, ranged widely in their wattage ratings and light output, but they differed relatively little in their attractiveness to insects. Lamps that strongly emit wavelengths in the near-ultraviolet range include clear, color improved, deluxe white, and white mercury vapor lamps.

The experiments were designed to test the inherent attractiveness of the lamps themselves, without accessories. Consequently, the scientists did not study effects of lamp shape, mounting height, luminaires, and surrounding obstructions, Mr. Barrett said.

Members of the research team also included Purdue University entomologist Roger T. Huber and ARS agricultural engineer Fred W. Harwood, formerly of Lafayette. □

New role for styrofoam trays

STYROFOAM meat trays are helping cut the cost of rearing cabbage loopers for research on developing biological control methods against this pest.

The cabbage looper is one of the most devastating pests in the world—ranking in the top 10 in the United States—and is the number one pest of lettuce in the Southwest. The little green worm chews his way through food crops, doing millions of dollars worth of damage each year. If left unchecked, it can devastate yields and send prices soaring.

Insecticides kill loopers effectively but ecologists fear the long term effects of insecticides on the environment. Moreover, many insects develop immunity to insecticides, hence the interest in biological control methods involving the production and release of parasites and pathogens.

The styrofoam meat trays have demonstrated their usefulness and could replace paraffin-coated cups and paraffined paper bags in rearing facilities for raising the insect to the 4th instar stage. Instar is the stage the insect is in between molts—when it sheds its "skin" in order to grow larger.

One small drawback is that while cups and bags can be used to raise the insects to pupation, the trays cannot. However, the fourth instar is the stage of growth scientists need for many phases of cabbage looper research.

Thirty-five loopers are raised in each paper cup; 150 can be raised in either bag or tray.

Although trays reduce costs, their greater advantage, says technician Merrill A. Patterson of Mesa, Ariz., is that use of a transparent cover allows researchers to monitor the developing loopers without risking contamination by removing lids or opening bags. If contamination occurs naturally in the trays, abnormalities can be observed readily and the tray discarded without endangering other loopers.

Cost comparisons show that raising 1,000 loopers to the fourth instar in cups cost—including labor—$1.56. With paper bags, cost per 1,000 loopers is 80 cents and with the meat trays, 44 cents. This is a 72 percent saving over the cups, and a 45 percent saving over the bags.

In raising loopers, a hot portion of artificial diet is poured into trays where upon cooling, it solidifies. Egg sheets containing about 150 looper eggs are then stapled to the center of the sheet of plastic—polyvinyl chloride (PVC). The diet-filled tray is inverted over the PVC and the loose edges secured to the bottom of the tray. When the eggs hatch, the larvae drop to the diet and begin feeding and growing to the required size. □

Remote sensing aids war on rust

SEVERITY of wheat leaf rust and the resulting reduction in wheat yield can be predicted from meteorological information collected by remote sensing techniques.

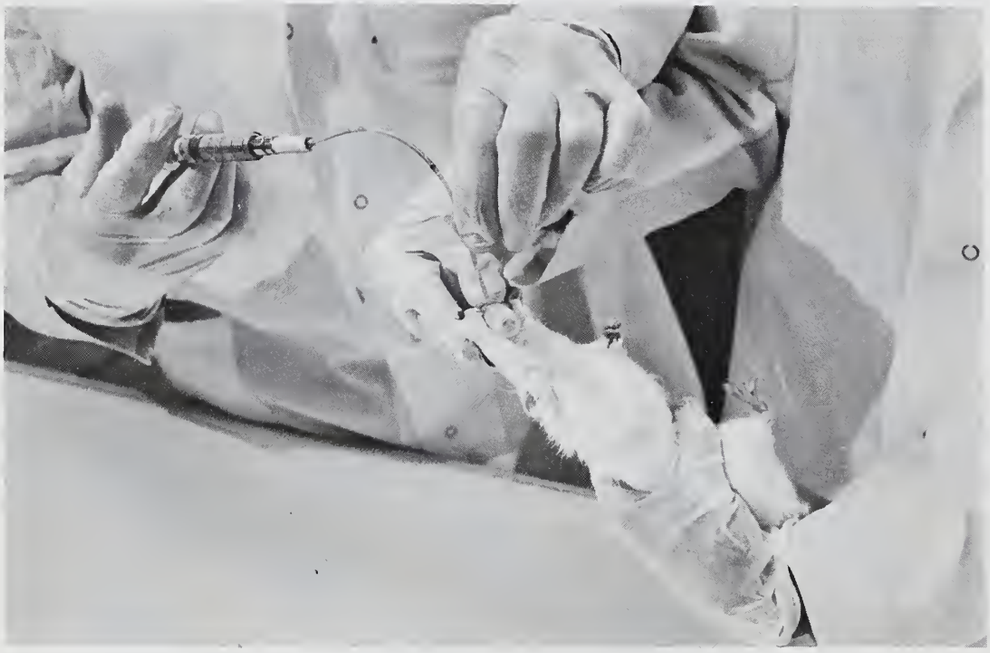
Calculations with data transmitted to Earth Technology Satellite–1 for a week in April 1973 predicted that yield reductions would be 9.2 and 9.1 percent in two Kansas wheatfields. At harvest, the researchers found that the actual yield losses from leaf rust were 12.3 and 9.3 percent, respectively.

ARS plant pathologist Merle G. Eversmeyer, Manhattan, Kans., calculated expected leaf rust losses using a prediction equation that he, former ARS plant pathologist James R. Burleigh, and Alan P. Roelfs of USDA's Animal and Plant Health Inspection Service had used successfully with data collected by standard meteorological instruments.

Advance warning of rust epidemics would alert growers in time to restrict losses by applying fungicides and to assist in the orderly marketing of the wheat crops, Dr. Eversmeyer points out. Predictions for wide areas of the grainbelt would require continuous gathering of meteorological and biological data from widely scattered fields—an expensive operation if done with conventional instrumentation. The Kansas study suggests that maintenance cost would be minimal if data-collecting platforms gather and transmit the data to a satellite.

In addition to Dr. Eversmeyer, those participating in the study were microclimatologist Edward T. Kanemasu, electronic technician Howard D. Schimmelpfennig, research associate E. Chin Choy, and electrical engineer Donald H. Lenhert of the Kansas Agricultural and Engineering Experiment Stations, Manhattan. The National Aeronautics and Space Administration provided partial support for the research. □

The ingesta-dose technique



Donor-ingesta containing agricultural chemicals is passed through a plastic esophageal tube directly into a rat's stomach (0174X54–32).

A NEW TECHNIQUE for simulating intake of pesticide-contaminated feed in laboratory animals promises to improve accuracy of studies on the metabolism of agricultural chemicals.

Metabolism describes the sequence of processes in an animal after introduction of a chemical, including its alteration or breakdown, absorption into the bloodstream, and deposition or elimination in the original or altered form. Information from such studies aids regulatory agencies in evaluating the safety of chemicals to which animals may be exposed and in determining necessary precautions in their use.

Scientists at the ARS Metabolism and Radiation Research Laboratory, Fargo, N. Dak., devised the technique after earlier studies produced conflicting results on the metabolism of carbaryl, an insecticide registered for use on forage, vegetables, cotton, and other crops.

In some experiments, essentially unaltered carbaryl was rapidly absorbed into the bloodstream of laboratory rats. In other experiments, extensive enzymatic breakdown of carbaryl and slower absorption were demonstrated. Whether or not a chemical undergoes alteration, or detoxification, in the intestinal tract can significantly affect the potential hazard of residues subsequently found in meat or milk or returned to the environment.

Methods of administering the pesticide differed in these experiments. Insignificant alteration of carbaryl occurred when it was given as a micro-dose directly into the stomach of a fasted rat, a standard technique. Extensive breakdown was reported when it was placed in sections of intestine removed from rats.

Physiologists Jerome C. Pekas and Jane L. Giles, both of ARS, reasoned that presence or absence of stomach contents, or ingesta, might partially explain the differing results. In addition, another related experiment by Howard H. Casper, presently at the North Dakota Agricultural Experiment Station, Fargo, had indicated that administration directly into the stomach of a fasted rat was equivalent to putting the carbaryl into the portal vein, bypassing the gastrointestinal tract. The dose was absorbed almost instantaneously.

The researchers point out that livestock and poultry usually are exposed to agricultural chemicals as residues in their feed. Tests with small liquid doses administered to fasted rats thus do not duplicate natural exposure. It is more closely simulated by administering a micro-dose of the chemical to the stomachs of fed animals, but failure to incor-

Engorged stomach taken from a normal rat holds 7 grams of ingesta or stomach contents. The tray is filled with rat ingesta that will be transferred to a syringe containing radiolabeled pesticide. When extruded, the ingesta-pesticide mixture will be administered to an experimental rat (0274X185–28).

porate the dose uniformly into the stomach contents, or ingesta, may be a source of experimental error. Further, preparation of representative doses of pesticides such as carbaryl is complicated by the fact that they are insoluble in water, and common solvents are themselves toxic.

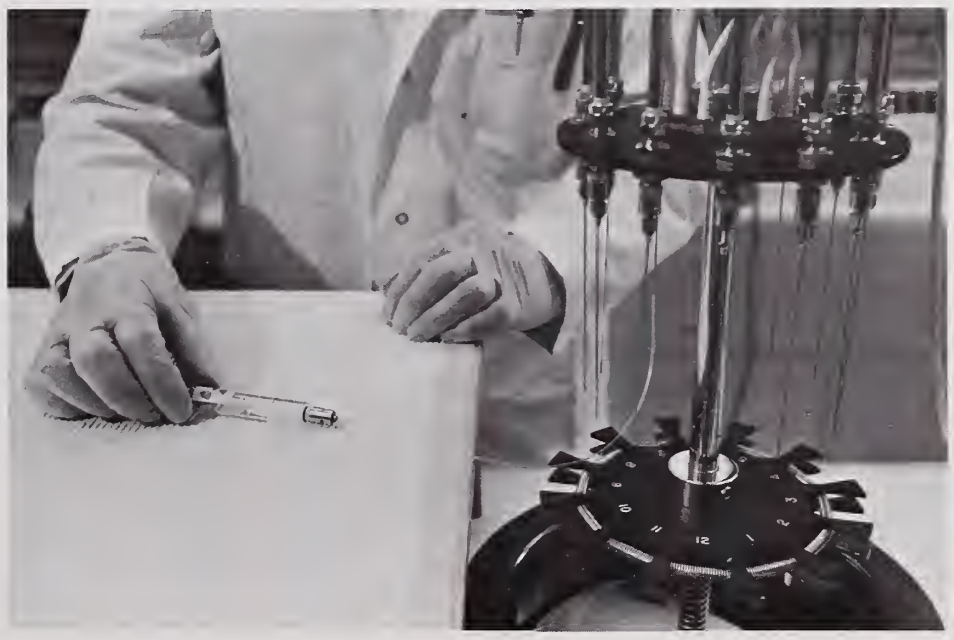
Natural exposure was more closely simulated by what the scientists call the donor-recipient ingesta exchange technique. It requires paired rats of similar breeding and age—a fed donor and a fasted recipient. The scientists recover the ingesta of the donor, incorporate the chemical dose uniformly, heat the ingesta-dose to 98° F., and orally administer it to the recipient.

Dr. Pekas and his associates used the same fasted rat as the test animal in comparing the new technique and the conventional micro-dose procedure. The rat first received an ingesta-dose of carbaryl, and absorption was monitored in samples of portal blood withdrawn at timed intervals for 20 hours. Twenty-four hours after the ingesta-dose and with no further feed intake, the rat received the same amount of carbaryl in a micro-dose. Absorption again was monitored. The part of the carbaryl molecule that would move into breakdown products, or metabolites, was radiolabeled with carbon-14 in both experiments.

Absorption rates were radically different in the same time intervals after administration. Concentrations of carbon-14 in portal blood were about 15 times lower after the ingesta-dose than after the micro-dose. Presence of ingesta in the stomach, with the new technique, definitely slowed gastrointestinal absorption. The slower rate of absorption likely affected the degree of breakdown of carbaryl before and after absorption, Dr. Pekas said.

Whether carbaryl is chemically altered in the intestinal tract was not conclusively demonstrated in the experiment. There was strong evidence, however, that enzymatic breakdown occurred within 3 minutes after administration of the ingesta-dose. After 40 minutes, nearly all of the carbon-14 recovered was associated with carbaryl metabolites. Still to be determined is whether the metabolites could have been formed from the metabolism of other tissues. □

Nitrogen is employed to evaporate toxic solvent from a dosing syringe so that radiolabeled pesticide is deposited on walls of syringe. This step is necessary to prevent solvent from confounding the experiment (0174X54–27).



Talcott W. Edminster, Administrator of ARS, chats with Dr. Harrar who a few minutes later delivered the sixth annual Atwater Memorial Lecture in San Francisco. Exhibit in background, developed to draw attention to W. O. Atwater's contributions to the science of nutrition, will be shown at several scientific and technical meetings this year (0374X269–10).

Nutrition and Numbers in the Third World

THE PROGRESS of civilization is squarely dependent on provision for adequate diet, health protection, education, and productive opportunity for all world citizens. Yet the world is far behind in achieving any reasonable balance between these needs and the satisfaction of their requirements. Foremost within the context of these world problems is the necessity to stabilize population increase.

These are the long-held views of scientist-humanitarian J. George Harrar, who presented the sixth annual Atwater Memorial Lecture. Dr. Harrar is a biologist and president emeritus of the Rockefeller Foundation and has, for three decades, been a principal strategist for international cooperation in nutrition research and in worldwide agricultural production.

In his lecture, "Nutrition and Numbers in the Third World," Dr. Harrar reiterated a theme that has underscored his lectures and writings for 30 years. He said world leaders and the public must become convinced that compounded population growth simply nullifies all efforts to create opportunities that establish an acceptable human condition.

Time is a critical factor and if present population trends continue, there could be upwards of 15 billion humans by the year 2025. If these numbers do occur, he said, then the least result will be severely reduced standards of living worldwide; for millions, this will undoubtedly mean chronic malnutrition and starvation. "Unless it is possible to stabilize the world population through prompt and measurable progress towards zero population growth, the ultimate result can only be chaos," he said.

Dr. Harrar links population stabilization with improved human nutrition, internationally planned sharing of agricultural production responsibilities, and the development of non-conventional methods of food production.

He called for a reallocation of priorities and resources directed toward maximizing the constructive use of the agrarian resources of all nations. Although conventional agriculture is still the principal hope for improving world economy and human nutrition, every effort must also be made to utilize unconventional methods, he said. Aquaculture and organized fishing systems, solar and geothermal energy utilization, new biological species through genetic manipulations, and exploitation of single cell proteins are a few examples.

"What is needed," Dr. Harrar concluded, "is a strong and sound basis on which to build a future world with a compassionate concern for those who will occupy it and one worthy of those who currently direct its destinies."

The 1974 Atwater Lecture was delivered in San Francisco, Calif., before the 140th meeting of the American Association for the Advancement of Science. Sponsored by ARS, the lecture honors USDA's first chief of human nutrition research, Dr. Wilbur O. Atwater.

Dr. Harrar was born in Painesville, Ohio, and earned his doctorate in plant pathology from the University of Minnesota, Minneapolis. He joined the Rockefeller Foundation in 1943 and was appointed trustee and president of the Foundation in 1961. He has published several books and over 50 technical papers. □

Reassessing feedlot waste

RESEARCH on the value of feedlot waste as fertilizer has taken on added interest as a result of rising cost, and sometimes scarce supplies, of commercial fertilizer.

ARS-Nebraska studies show that a ton of beef manure contains about 14 pounds of nitrogen, 4 pounds of phosphorus, 9 pounds of potassium, and trace amounts of boron, cobalt, copper, manganese, and molybdenum. And the most practical use of nutrients found in some 2 billion tons of animal waste produced in the United States each year is the application on land in solid or liquid form.

Thomas M. McCalla, ARS microbiologist, Lincoln, Neb., says that 10 to 20 tons of manure, incorporated into the soil, is needed to provide 150 pounds of available nitrogen per acre. About half of the nitrogen in manure is available to crops the first year. In subsequent years, the manure application rate should be regulated by the carryover of nitrogen and other nutrients as determined by a soil test.

Too much manure can cause an excess of phosphorus which may be carried off the land with surface runoff water to pollute streams and other bodies of water. Excessive phosphorus can interfere with zinc uptake by plants and result in zinc deficiency, and it can cause ruminants to suffer from grass tetany.

Such problems arise where manure in excess of 50 tons per acre is put on year after year, Dr. McCalla said. A 39-year experiment at Scottsbluff, Neb., however, indicates that 10 to 30 tons of manure per acre can be put on every year with beneficial effects on soil properties and crop yields.

Pheromone for codling moths

SPRAYING A FIELD with myriad tiny capsules containing codling moth pheromone, a female sex attractant, so confuses male codling moths that the insect pests are unable to find females, hence unable to mate.

Codling moths in the larvae stage are the all-too-familiar "worm in the apple." World-wide distribution and a voracious appetite give the insect number one status as an apple pest. Each year codling moths cause West Coast fruit growers alone over $6 million in crop damage and control costs.

Pheromones were first used to bait traps to capture male moths, revealing flight patterns and abundance of moths. Both natural and synthetic attractants proved better than virgin females, originally used as trap lures. Unlike virgin females, pheromones provide a concentrated stimulus that is continually reinforced.

Employing an encapsulation technique developed by ARS chemists Morton Beroza and Terrence P. McGovern, Beltsville, Md., ARS entomologists Harold R. Moffitt and Darrell L. Hathaway, Yakima, Wash., sprayed a 1-acre field with pheromone-containing capsules at the rate of 3 grams of pheromone per acre.

One thousand sterile moths—500 male and 500 female—were released in the center of the field in a preliminary test. Four baited traps surrounded the release area. By counting the number of males capable of responding to the traps, Dr. Moffitt and Dr. Hathaway determined the capsules' effectiveness. The significant lack of response to the traps indicated that being surrounded by thousands of "turned on females" in the form of pheromone capsules so confused the male moths that they were unable to locate and respond to a specific attractant.

The 3 grams per acre concentration of pheromone was an arbitrary figure, picked as a starting point. Other concentrations will be tried. Another future step is to spray the field again, only this time release fertile insects. This will show whether or not mating and reproduction is actually reduced.

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Stretching the avocado season

AVOCADO LOVERS may soon be able to find this delectable fruit on produce counters all year long, thanks to the successful adaptation of controlled atmosphere storage techniques.

Many problems with chilling injury and decay make cold storage of avocados for more than 3 weeks impossible. If temperatures are above 50° F., decay will destroy the fruit, while at storage temperatures below 50° F., chilling injury ruins fruit quality through discoloration of rind and flesh.

Due to these problems, producers have traditionally sent avocados to market promptly after harvest, causing an "all or nothing" supply situation. This leaves roughly 4 months when avocados are not available and supplies of the large Florida varieties could command premiums.

Success of controlled atmosphere storage in the apple industry led to adaptation of this approach for avocados by scientists at the ARS Subtropical Horticulture Research Station, Miami, Fla.

The composition of normal air is 21 percent oxygen, 0.03 percent carbon dioxide, with the rest mainly nitrogen. Avocados stored in an atmosphere of 2 percent oxygen and 10 percent carbon dioxide had up to twice the storage life of comparable fruit stored in air.

Lowered oxygen decreased the respiration rate which retarded ripening and softening of the avocados. Combination of the low oxygen and high carbon dioxide tended to inhibit development of chilling injury and decay. Decay in Florida avocados is mainly anthracnose. Retarded ripening held the fruit in a stage of development resistant to the anthracnose fungus.

Combined with the use of early and late ripening avocado varieties, successful development of controlled atmosphere storage for avocados can mean that the fruit can be marketed on a year-round basis.

The research was initiated by ARS horticulturist Thurman T. Hatton, Jr. and technician William F. Reeder and continued by plant pathologist Donald H. Spalding.

New emetic from moldy corn

A new emetic has been isolated from moldy corn, chemically identified, and named "vomitoxin" by scientists of ARS and the University of Illinois.

Instances of hogs vomiting after eating corn infected with *Fusarium* molds were reported throughout the Corn Belt in 1972. *F. graminearum* is common on corn but the organism needs high moisture levels to grow.

High moisture corn and poor drying conditions were common that year.

Starting with corn that caused pigs to vomit, Ronald F. Vesonder, chemist, and Alex Ciegler, microbiologist, both at the ARS Northern Regional Research Laboratory, Peoria, Ill., ground the corn and performed 10 fractionations. Each fractionation consisted of a number of steps designed to progressively separate other materials from the emetic until it was pure.

Using pigs as test animals, Alvin H. Jensen, Illinois animal scientist, followed the purification progress by testing successive fractions for the presence of the emetic. He tested 14 fractions including the final one, purified vomitoxin.

It is a new member of a class of compounds, thrichothecenes. They are relatively inert chemically, but some are toxic.

Research is continuing to determine whether the emetic also causes hogs to refuse to eat moldy corn.

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